REMARKS

Claims 1, 3-7, 9-15 and 17 are pending in this application. No amendment is made in this Response. It is believed that this Response is fully responsive to the Office Action dated January 14, 2009.

Regarding the IDS filed on August 2, 2006.

The PTO Form 1449 from the IDS filed on August 2, 2006, was returned with the previous Office action (September 10, 2008) with three references lined through: JP3355442, JP10-223048, and JP2002-290094. The reason for these references being lined through was not explained.

Although Applicant believes that the listing of these documents in the IDS filed on August 2, 2006, was proper, Applicant again requests consideration of these references in the concurrently filed Information Disclosure Statement. The concurrently filed IDS includes an English translation or abstract for each of these three references.

Claims 1, 3-7, 9-15, and 17 are rejected under 35 U.S.C. §103(a) as being unpatentable over Glatkowski et al. (US 2003/0008123 A1) in view of Matsui et al. (WO 2004/40509) and Nishino et al. (US 2003/0175462 A1). Notes: US 6,960,334 is being relied upon as English equivalent of WO 2004/40509). (Office action paragraph no. 5)

Reconsideration of the rejection is respectfully requested.

Regarding the Combination of Matsui with Glatokowski

In citing portions of Matsui WO'509 in Applicant's argument below, Applicant cites the page and line numbering of US 6960334 B1, which is the U.S. patent application corresponding to Matsui and relied on by the Examiner as an English translation.

The Examiner states that Matsui teaches nanotubes having the structure recited in claim 2, and that the "amorphous nanoscale carbon tubes are durable for repetitive use and possess excellent mechanical, electronic, and chemical properties; and that the disclosed method allows mass production, in high yield and high purity, of the amorphous carbon nanoparticles" (page 4, lines 3 to 7, of the Office Action). This is stated as the motivation for substituting these nanotubes for the nanotubes in Glatkowski.

However, Matsui focuses on increasing **gas absorption** storage capacity and durability compared to those of conventional carbon nanotubes (see column 2, lines 40 to 44 of Matsui). Matsui **does not describe using amorphous nanoscale carbon tubes as dielectrics**. The description "excellent in electronic properties" as an object of the invention at column 2, line 33, in Matsui is overly vague, broad and unclear in meaning. The "electronic properties" may refer to column 9, lines 35-46, of Matsui, where use as an electron beam emitter or X-ray source is disclosed. However, this use would not be relevant to Glatkowski. Therefore, it would not have been obvious to one skilled in the art to use these amorphous nanoscale carbon tubes as dielectrics, and there is no motivation for substituting these nanotubes for those in Glatkowski. In addition, Applicant notes that there is no suggestion in Matsui that the incorporation of

amorphous nanoscale carbon tubes into a resin can in any way affect the loss tangent, tanδ, discussed by Glatkowski as an important parameter at [0067].

In regard to the basic combination of Matsui and Glatkoswski, Applicant also responds to the Examiner's comments in the Response to Arguments on page 6 of the Office action. The Examiner states that Applicant had argued, at page 13, 3rd to last paragraph, of the last Amendment, that the carbon nanotubes of Matsui would not work if incorporated in a resin such as taught by Glatkowski. However, this is a **misstatement** of Applicant's argument. Applicant had argued that the nanotubes would not work **for the intended purpose of Matsui** (i.e., **hydrogen-absorption**) if placed in a resin. This is a proper argument based on *In re Gordon* (See MPEP 2143.01 (V)), and Applicant maintains this argument attacking the *prima facie* case of obviousness.

In addition, the Examiner states on page 6, lines 15 to 21 of the Office Action that:

> "for the purpose of Incorporation in a resin, conventional carbon nanotubes or those taught in Matsui can be said to be equivalent and can be used interchangeably, as evidenced from the fact that **the applicant has no preference for one over the other (Specification, pages 7-8 and 15)**. If anything, the carbon nanotubes taught by Matsui and Nishino are BETTER than conventional carbon nanotubes in terms of ease of their incorporation in a resin as disclosed by the applicant (Specification, p. 15, lines 13-21)" (emphasis added)

However, Applicant respectfully submits that this is an improper argument, for the following reasons:

First, this modification of the reference would require that the interchangeability must have been known prior to the filing of the application. However, the Examiner specifically refers to the specification

of the application and the Applicant's preference. This is an improper hindsight use of the specification, and of data obtained by the inventor.

The Examiner has not cited any prior art reference showing that it is known that conventional carbon nanotubes, iron-carbon composites and amorphous carbon nanotubes can be "interchangeably" used. This clearly is not taught in the Matsui, Nishino and Glatkowski references.

Furthermore, the Examiner states that: "Glatkowski looks for carbon nanotubes with good electrical property [0062]" and "Glatkowski does not teach away from using carbon nanotubes taught In Matsui..." (page 6, lines 5 to 7 of the Office Action). As noted above, the only electrical properties specifically discussed in Matsui appear to be the use as an electron beam emitter or X-ray source. The fact that Glatkowski does not specifically teach away from using Matsui's nanotubes is irrelevant.

Even though Glatkowski generally teaches that incorporation of carbon nanotubes yields a good dielectric, persons skilled in the art would not predict, with a reasonable expectation of success, that incorporation of Matsui's amorphous nanoscale carbon tubes, which are quite different in many aspects from the conventional carbon nanotubes used by Glatkowski, would have similar properties.

Unexpected results of the present invention over Matsui and Glatkowski

Glatkowski describes (in the Abstract, etc.) that incorporation of conventional carbon nanotubes into a polymer matrix can increase the dielectric constant of a polymer matrix. Thus, the invention of

Glatkowski teaches **increasing tanδ** by incorporating conventional carbon nanotubes into a polymer matrix.

Applicant also submits that incorporation of conductive materials into a resin is generally believed in the art to **increase tanδ**. In support of this argument that incorporation of conductive materials into a resin tends to increase tanδ, Applicant refers to Zois et al., "Dielectric Properties and Morphology of Polymer Composites Filled with Dispersed Iron," *Journal of Applied Polymer Science*, Vol. 88, 3013-3020 (2003), made of record in the concurrently filed IDS.

Figure 2 of Zois et al. is a graph showing the dielectric constant and tanδ of various resins containing iron as a conductive material. In Figure 2, P_c denotes the percolation threshold (page 3014, right column, lines 28 to 30, etc., of Zois et al.), and P the filler volume concentration (page 3014, right column, line 44, etc., of Zois et al.).

Zois et al. discloses that: "The relationship between the dielectric permittivity, ε' and the metal volume fraction, P, near the percolation threshold obeys the power law dependence on the distance from threshold, P_c-P, shown in eq. (1). To determine the value of the critical exponent s, log ε' is plotted as a function of the reduced filler concentration, $\log[(P_c-P)/P_c]$..." (page 3016, left column, line 10 to right column, line 3, of Zois et al.).

Eq. (1): $\varepsilon' \propto (P_c-P)^{-s}$, for $P < P_c$

When iron is not added, i.e., when $P = 0$, the log $[(P_c-P)/P_c]$ of the abscissa is 0. As more iron is added, the log $[(P_c-P)/P_c]$ of the abscissa decreases. Specifically, the amount of iron added is larger on the left side of Fig. 2.

Fig. 2 (a) shows that the closer to the left side, i.e., the larger the amount of iron added, the higher the dielectric constant.

Further, Zois et al. discloses that 'The concentration dependence of tanδ for all the composites studied is described by eq. (2).... The values of the critical exponent, r, are given by the slope of the least-squares fitting line in plots of log(tanδ) vs. log$[(P_c-P)/P_c]$." (page 3016, right column, lines 23 to 29, of Zois et al.)

Eq. (2): $\tan\delta \propto (P_c-P)^{-r}$, for $P < P_c$

Fig. 2 (b) shows that the closer to the left side, i.e., the larger the amount of iron added, the higher the tanδ.

These results clearly show that when a conductive material is incorporated into a resin, there is a correlation between the dielectric constant and the tanδ. The higher the dielectric constant, the larger the tanδ.

As is clear from the above Zois et al., incorporation of a conductive material would increases tanδ. Amorphous nanoscale carbon tubes disclosed in Matsui are also conductive material. Therefore, a person

skilled in the art **would predict that the incorporation of amorphous nanoscale carbon tubes as disclosed in Matsui into a resin would also increase tanδ.**

Surprisingly, however, the incorporation of a small amount of said amorphous carbon nanotubes into a resin according to the present invention **can reduce tanδ, which is clearly an unexpected result.**

Even though Glatkowski discloses that incorporation of a small amount of carbon nanotubes can lower tanδ, the prior art documents neither describe nor suggest that the incorporation of a small amount of the amorphous carbon nanotubes of Matsui can lower tanδ.

<u>Regarding the combination of Glatkowski and Nishino</u>

As motivations to combine Glatkowski with Nishino, the Examiner states (on page 4, lines 10 to 15 of the Office Action) that:

> "Nishino also teaches that the disclosed composite containing iron-carbon composites can be synthesized in large quantities [0104], possesses excellent durability [0163], and, when a small amount of which is added to a resin, increases electrical conductivity ... of the resulting articles without a giving negative impact on the transparency, hue and so forth of the resin [0166-0168]."

The Examiner further states that:

> "another important advantage of the disclosed composite is that, while the electrical properties of normal CNTs are dictated by the structure of the walls and controlling said structure poses a significant challenge, the electrical properties of disclosed iron-filled CNTs are dictated by the contained metal rather than by the carbon wall structure and, therefore, controlling those properties is made easier [0164-0165]." (page 4, lines 15 to 19 of the Office Action).

The Examiner also repeats the argument that increased conductivity can reduce tanδ.

Applicant's above arguments regarding the combination of Matsui and Glatkowski are also applicable here. Again, general art would predict that incorporation of carbon nanotubes into a resin would increase tanδ, while in the present invention, incorporation of the recited nanoscale carbon tubes can decrease tanδ.

<u>Regarding Applicant's previous argument of Unexpected Effects of the Claimed Invention</u>

Applicant had previously argued that there are unexpected results for the present invention, and the Examiner responds that:

> "applicant's allegation that the instant invention has unexpected results ... that are not taught by the prior art is not true as Glatkowski repeatedly teaches that the filler ... should be incorporated in a resin in an amount below its percolation threshold in order to minimize dielectric loss (i.e., in order to have low tanδ)" (page 7, lines 1 to 5 of the Office Action).

In response, Applicant argues with reference to Figs. 6, 8, and 9 of the subject application.

Figs. 6 and 8 of the present Specification show that the tanδ of the samples of Examples 2,3, and 6 (amorphous nanoscale carbon tubes or iron-carbon composites) is kept low, i.e., at about 0.04 to about 0.06, even in a very high frequency region of 20 GHz (at the right end of the graph).

In contrast, Fig. 9 of the present Specification shows that the tanδ of the sample of Example 7 (conventional carbon nanotubes) starts to sharply increase at a frequency exceeding 10 GHz. The sample of Example 7 has a tanδ of 0.1 in a very high frequency region of 20 GHz (at the right end of the graph),

which is equivalent to the level achieved by the plain resin containing no additives of Comparative Example 1.

Thus, the amorphous nanoscale carbon tubes of the claimed invention achieve an unexpectedly remarkable effect, i.e., keeping the tanδ low **not only in the region less than 10 GHz but also in a very high frequency region**.

Summary

Applicant has presented arguments attacking the basic motivation to combine the Matsui and Glatkowski references, and also demonstrating that the results of the present invention are clearly unexpected over the Matsui, Glatkowski and Nishino references. Claims 1, 3-7, 9-15, and 17 are therefore not obvious over Matsui, Glatkowski and Nishino, taken separately or in combination.

If, for any reason, it is felt that this application is not now in condition for allowance, the Examiner is requested to contact the applicants' undersigned agent at the telephone number indicated below to arrange for an interview to expedite the disposition of this case.

In the event that this paper is not timely filed, the applicants respectfully petition for an appropriate extension of time. Please charge any fees for such an extension of time and any other fees which may be due with respect to this paper, to Deposit Account No. 01-2340.

Respectfully submitted,

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